Worksheet: Electronegativity, polar, nonpolar, and ionic bonds.

What is an ionic bond?

What is a covalent bond?

What is a polar covalent bond?

What is a nonpolar covalent bond?

What is electronegativity?

1. Arrange the following elements in order of increasing force of attraction between the nucleus and the electrons.

a. arsenic, gallium, germanium, radium, sulfur

b. aluminum, potassium, francium, nitrogen, iodine

2. Classify the bonds as polar, nonpolar, or ionic. Show the electronegativity difference.

a. boron-carbon f. beryllium-fluorine

b. cesium-fluorine g. bromine-strontium

c. fluorine-silicon h. chlorine-chlorine

d. hydrogen-chlorine i. chlorine-sodium

e. magnesium-nitrogen j. hydrogen-hydrogen

3. Fill in the chart.

Bond Pair Electron Difference % ionic % covalent ionic/covalent p,np,neither

a. sodium-

oxygen

b. hydrogen-

hydrogen

c. lead-

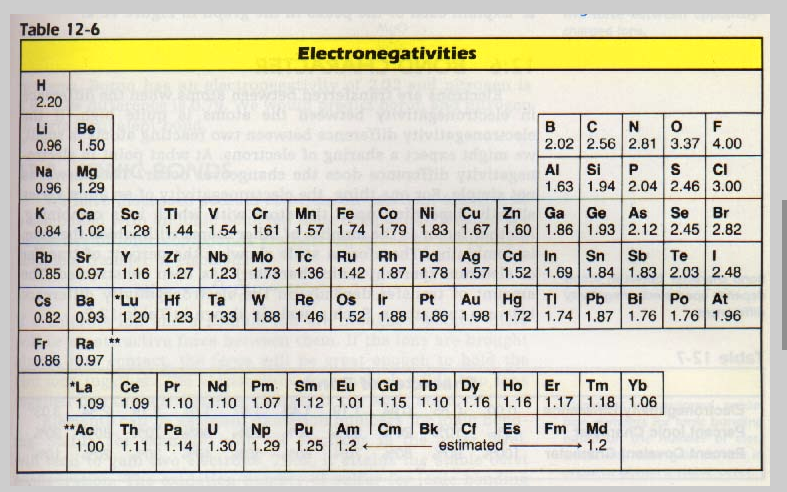
sulfur

d. carbon-

nitrogen

e. magnesium-

iodine



1. What are valence electrons? What is the pattern for valence electrons from the periodic table? Where are the transitional elements on the periodic table?

2. What is Lewis Dot structure? What is the pattern for the number of dots and the arrangement of dots on an atom?

For the following, state the

a)number of valence electrons

b)number of dots for the Lewis dot structure

c)draw the Lewis dot structure

1. Ne

2. H

3. Al

4. He

5. Mg

6. Cl

7. P

8. K

9. Fe

10. C

11. O

12. Cu

New vocabulary:

1. octet rule

2. central atom

3. polyatomic ion

4. lone pair

5. single bond

6. double bond

7. triple bond

8. molecular geometry

9. linear

10. bent

11. trigonal planar

12. pyramidal

13. tetrahedral

14. bond type

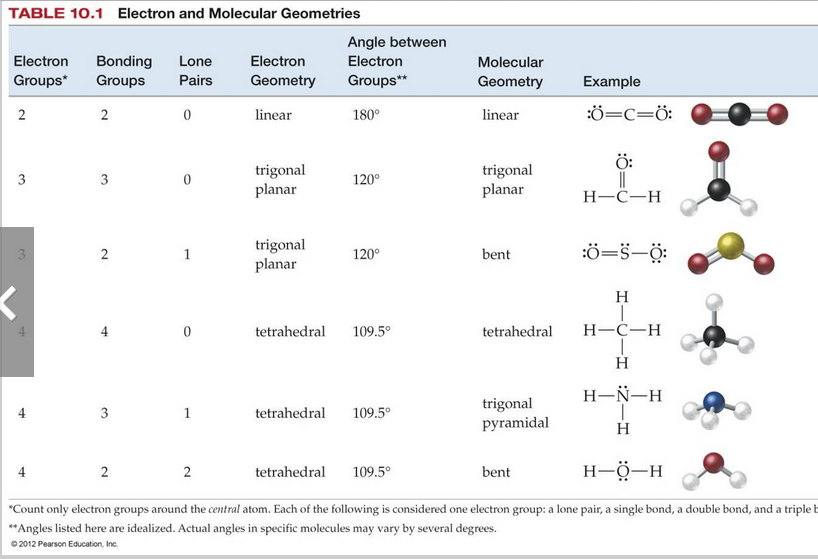
15. molecule type

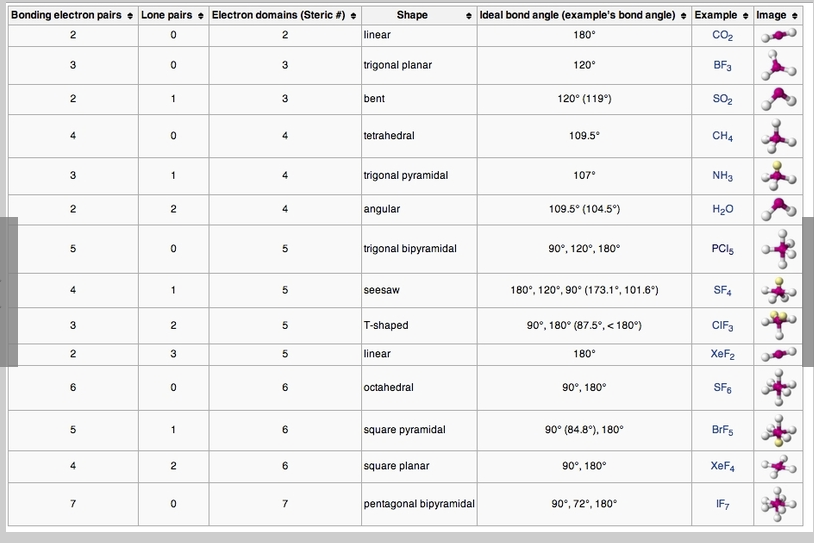
16. symmetry

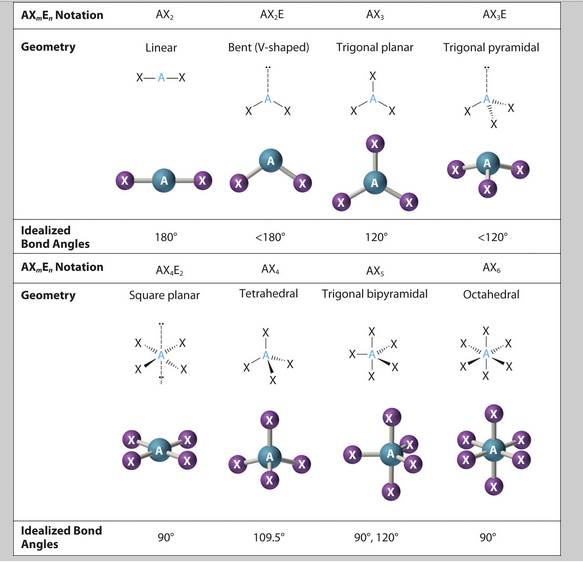
17. resonance

Additional molecular geometry for those who want a challenge or are taking AP chemistry:

T shaped, see-saw, square planar, trigonal bipyramidal, square pyramidal, octahedral, pentagonal bipyramidal.







Species # of e-‘s BondType Lewis Dot MoleculeType Geometry Resonance?

w/ Bond<

1. H2

2. F2

3. HF

4. H2O

5. NH3

6. AlCl3

7. CH4

8. CO2

9. Cu2O

10. N2

11. NH4+

12. MnO4-

Species # of e-‘s BondType Lewis Dot MoleculeType Geometry Resonance?

w/ Bond<

1. Cl2

2. O2

3. HCl

4. PI3

5. CCl4

6. H3O+

7. CrCl3

8. FeO

9. CO3-2

10. CN-

11. CrO4-2

# **Building Covalent Molecules** Lab #\_\_\_\_\_ Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Using model kits is a good way to see the **bonds** and **bond angles** present in a molecule. In this activity, molecules will be built and the bonds within them will be examined. As well, **intermolecular forces** between several separate molecules will be modeled.



**Learning the Parts of the Model Kit**

Identify what each of the following components of the molecular model kit represents.

|  |  |  |
| --- | --- | --- |
| **Color of Ball** | **Number of Holes**  **(Bonding Sites)** | **Name of Element** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

|  |  |
| --- | --- |
| **Type of Bond** | **Connector** |
| Single Bond | Stick |
| Double Bond | Spring |
| Triple Bond | Spring |

**Constructing Molecules**

Construct the following covalent molecules using the molecular model kits. Draw each molecule with the correct bond angles and identify if the molecule is symmetrical or asymmetrical.

Table 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Formula  Total # of e-‘s | Bond Type | Lewis Dot  w/Bond < | Molecular  Geometry | Molecule  Type |
| H2 |  |  |  |  |
| Cl2 |  |  |  |  |
| O2 |  |  |  |  |
| N2 |  |  |  |  |
| HCl |  |  |  |  |
| BrCl |  |  |  |  |
| HBr |  |  |  |  |

Table 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Formula  Total # of e-‘s | Bond Type | Lewis Dot  w/Bond< | Molecular  Geometry | Molecule  Type |
| H2O |  |  |  |  |
| CO2 |  |  |  |  |
| H2S |  |  |  |  |
| NH3 |  |  |  |  |
| CH4 |  |  |  |  |
| CCl4 |  |  |  |  |
| CH3Cl |  |  |  |  |

**Analyzing Bonds in the Molecules**

1. Analyze the bonds found in the molecules using reference tables and the chart below

|  |  |  |  |
| --- | --- | --- | --- |
| **Elements Involved in Bonding** | **Difference in Electronegativity**  (Regents Table S) | **Type of Bond**  (Non-Polar Covalent  or Polar Covalent) | **Percent Ionic Character** (Conversion Chart) |
| H – H |  |  |  |
| O – O |  |  |  |
| H – O |  |  |  |
| H – Cl |  |  |  |
| C – O |  |  |  |
| C – H |  |  |  |
| C – Cl |  |  |  |
| N – H |  |  |  |

**Determining Molecular Symmetry**

Based on the molecular symmetry and the types of bonds present, identify each molecule as a polar molecule or non-polar molecule. As well, use the information below to make your choices.

**Covalent Molecules with Covalent Bonds**

### Non-Polar Molecules

#### Polar Molecules

Molecule contains Polar Covalent Bonds and its Shape is Asymmetrical

Molecule contains Polar Covalent Bonds, but its Shape is Symmetrical

**Molecule contains Non-polar Covalent Bonds ONLY**

2.Classify the following as polar covalent **molecule**, nonpolar covalent **molecule** or ionic crystal.

1. Br2

2. MgCl2

3. HI

4. BaBr2

3. Both water and carbon dioxide are triatomic molecules. Explain why one of these is polar and the other is nonpolar **molecule** type. Show the Lewis Dot structure and bond angles for both.

Honors classes, try these for a challenge:

There is one of each of the following:

Linear, T shaped, see-saw, square planar, trigonal bipyramidal, square pyramidal, octahedral.

Formula

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Formula | Total # of e-‘s | Bond Type | Lewis Dot  w/Bond < | Molecular  Geometry | Molecule  Type |
| SF6 |  |  |  |  |  |
| BrF5 |  |  |  |  |  |
| XeF4 |  |  |  |  |  |
| HCN |  |  |  |  |  |
| ClF3 |  |  |  |  |  |
| TeCl4 |  |  |  |  |  |
| PCl5 |  |  |  |  |  |

PRACTICE TEST #1

FOR THE FOLLOWING MOLECULES, DO THE FOLLOWING:

A) STATE THE TOTAL NUMBER OF VALENCE ELECTRONS INVOLVED IN BONDING

B) BOND TYPE

C) LEWIS DOT STRUCTURE WITH BOND ANGLE(S)

D) MOLECULE TYPE

E) MOLECULAR GEOMETRY

F) DOES IT HAVE RESONANCE?

CO2

AsH3

BCl3

SiBr4

OF2

FOR THE FOLLOWING MOLECULES, DO THE FOLLOWING:

A) STATE THE TOTAL NUMBER OF VALENCE ELECTRONS INVOLVED IN BONDING

B) BOND TYPE

C) LEWIS DOT STRUCTURE WITH BOND ANGLE(S)

D) MOLECULE TYPE

E) MOLECULAR GEOMETRY

F) DOES IT HAVE RESONANCE?

O2

LiF

Al I3

NF3

CH4

Na2S

Fill in the chart.

Bond Pair Electron Difference % ionic % covalent ionic/covalent p,np,neither

a. sodium-

fluorine

b. oxygen-

oxygen

c. copper-

bromine

d. carbon-

oxygen

e. calcium-

iodine